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A Smart Approach for Traffic Management

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ABSTRACT: *This paper is aimed at designing a density based dynamic traffic signal system where the timing of signal will change automatically on sensing the traffic density at any junction using the IoT technology. Traffic congestion is a severe problem in most cities across the world and therefore it is time to shift more manual mode or fixed timer mode to an automated system with decision making capabilities. To optimize this problem, we have made a framework for an intelligent traffic control system. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time. We therefore propose here a mechanism in which the time period of green light and red light is assigned on the basis of the density of the traffic present at the time. This is achieved by using LIDAR sensors.*

In addition, when the emergency services are present on the particular lane, the clearance is given to that lane. This is achieved by providing a wifi module in the emergency vehicles. The SSID of the vehicle is scanned by Node MCU at the traffic pole and clearance is given.

KEYWORDS: *Emergency services, IoT, Node MCU, Traffic Congestion, LIDAR sensor*

I. INTRODUCTION

Due to the massive growth in urbanization and traffic congestion, intelligent vision-based traffic light controller is needed to reduce the traffic delay and travel time especially in developing countries as the current automatic time-based control is not realistic while sensor-based traffic light controller is not reliable in developing countries. Traffic congestion is now considered to be one of the biggest problems in the urban environments. Our approach is based on the alteration of traffic signal based on the vehicle density, which is the clever approach for traffic management. If the emergency vehicles like Ambulance, Fire engine are blocked in the traffic jam, the need of the service can't be fulfilled within specified time. Traffic problems will be also much more widely increasing as an expected result of the growing number of transportation means and current low-quality infrastructure of the roads.

II. LITERATURE REVIEW

In general cases, the traffic management is based on the time, which is an inefficient way of clearing the traffic. In the year 2015, Mr. Ranganathan has proposed a new approach for the traffic management based on the density of the vehicles in the particular lane. In his approach, the clearance will be given to the lane having the high density of vehicles. The density of the vehicles will be calculated using the IR sensors, which are harmful to the human life. By this approach, the service will be provided to the lane whichever having highest number of vehicles. But the main disadvantage of this approach is, the emergency vehicles will be given equal priority as general vehicles. In such cases, the need of the emergency service will not be fulfilled. By our approach, the enhancement is given to the above implementation. In which emergency vehicles are given higher priority since they will be having wifi module in it. The microcontroller at the traffic pole detects the SSID and the clearance is given also the IR sensors are replaced by the CJ VL53L0XV2 LIDAR sensor, which doesn't affect the human life.

III. HARDWARE REQUIREMENTS

Node MCU: Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi Source code from Espressif System and hardware which is based on the ESP-12 module.

CJ VL53L0XV2 LIDAR sensor : This sensor is a carrier/breakout board for ST's VL53L0X laser-ranging sensor, which measures the range to a target object. The VL53L0X uses time-of-flight measurements of infrared pulses for ranging, allowing it to give accurate results independent of the target's colour and surface.

C level converter: The logic level converter is a small device that safely steps down 5V signals to 3.3V and steps up 3.3V to 5V. Each level converter has the capability of converting 4 pins on the high side to 4 pins on the low side. Two inputs and two outputs are provided for each side. This can be used with normal serial, I2C, SPI, and any other digital signal and does not work with an analog signal. The level converter is very easy to use.

TCA9548A I2C Multiplexer: The TCA9548A device has eight bidirectional translating switches that can be controlled through the I2C bus. The SCL/SDA upstream pair fans out to eight downstream pairs, or channels. Any individual Scan/SD channel or combination of channels can be selected, determined by the contents of the programmable control register. These downstream channels can be used to resolve I2C slave address conflicts.

IV. SOFTWARE REQUIREMENTS

Arduino: Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed and ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. We can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE.

IOT: The Internet of Things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infra-structure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

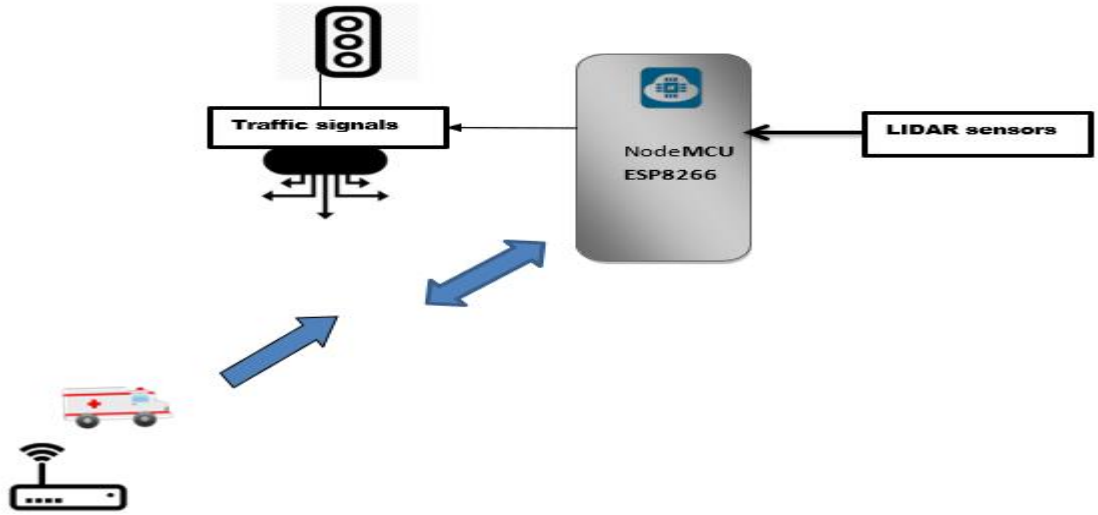
MQTT: MQTT (MQ Telemetry Transport or Message Queuing Telemetry Transport) is an ISO standard (ISO/IEC PRF 20922) publish-subscribe-based messaging protocol. It works on top of the TCP/IP protocol. It is designed for connections with remote locations where a "small code footprint" is required or the network bandwidth is limited.

MQ Telemetry Transport is a publish-subscribe pattern based "light weight" messaging protocol. The protocol is often used in the the IoT, “Internet of Things” world of connected devices. Its designed for built-in systems, mobile phones and other memory and bandwidth sensitive applications. Cloud AMQP do recommend the AMQP protocol in favor of the MQTT protocol.

V. WORKING

Our implementation provides a smart way to clear the traffic efficiently with prioritising the emergency services by using “Internet of Things” technology. The hardware components in this project are Node M CU, LIDAR sensor, I2C multiplexer, 16-bit analogy multiplexer, LEDs, Bread board, Jumper wires and power supply. And the software components include Arduino. IDE and MQTT.

Block Diagram:



Lidar sensors which are present on the signal pole senses the number of vehicles passed in the respective lane. The count of vehicle is passed to the signal pole through the MQTT. MQTT consists of publish, subscribe and broker.

As the sensors turn smart due to the Node MCU, it could publish the count of vehicles and the microcontroller at the traffic pole subscribes it and the traffic signals are altered based on the traffic density. The cloud which is shown in the block diagram is the broker through which publishing and subscription is done. In the case of emergency vehicles, the vehicle consists of the wifi module in it, the SSID of the vehicle will be scanned by the microcontroller at the traffic signal. WIFI scanner program will be executed and checked with the SSID of the vehicle, when it matches with that of the vehicle the traffic signal alteration is done. And in this way the clearance to the lane in which emergency vehicles are present, is achieved.

VI. RESULTS AND DISCUSSIONS

This project is implemented successfully to reduce the traffic congestion by using the Internet of Things (IoT) technology and MQTT. By implementing this approach in real life, traffic clearance will be done within the minimum time lapse which makes it more efficient. And the emergency services are given the higher priority, fulfilling the emergency need.

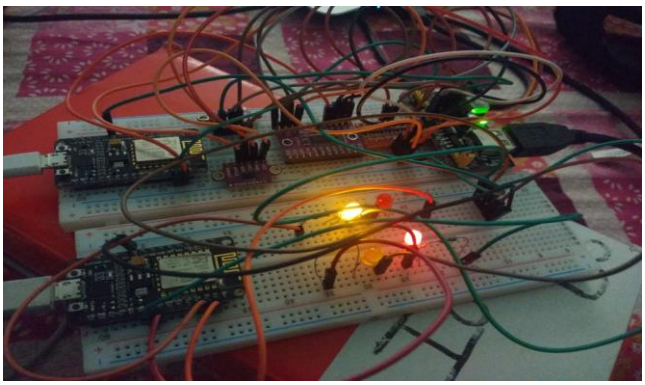


Fig.1 Showing one green light and red light is turned ON

The above figure shows the turning ON of the green light and red light in the lane1 and lane2 respectively, When the number of vehicles in lane1 is higher than the number of vehicles in lane2. After certain time lapse the signal then shifted to another lane based on the density of the vehicles.

VII. ADVANTAGES

1. Traffic management can be achieved more effectively.
2. Traffic Congestion can be cleared within minimum amount of time.
3. Human interference is not required for the traffic control.
4. Emergency services are given the highest priority, fulfilling the emergency situation.

VIII. CONCLUSION

There is exigent need of efficient traffic management system in our country, as India meets with 384 accidents every day. To reduce this congestion and unwanted time delay in traffic an advanced system is designed here in this project. With the field application of this technology, the maddening chaos of traffic can be effectively channelized by distributing the time slots based on the merit of the vehicle load in certain lanes of multi junction crossing. Emergency vehicles need to reach their destinations at the earliest. If they spend a lot of time in traffic jams. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. The signal turns to red, only after the emergency vehicle passes through. Currently, it is implemented system by considering one road of the traffic junction. We have successfully implemented the prototype at laboratory scale with remarkable outcome. The next step forward is to implement this schema in real life scenario for the first-hand results, before implementing on the largest scale. We believe that this may bring a revolutionary change in traffic management system on its application in actual field environment.

Future Scope: As part of future advancements, the traffic check post may be connected by wireless transmitters by which the crossing ahead may be achieved the connecting sensor network with GPS connectivity and short-wave radio transmission signals. This will act as a feed forward system making the signalling system even smoother and congestion free. Our project can also be advanced in the creation of new indication, which implies the turning off the vehicle engine if the time required for the traffic clearance is high. This can be achieved by

predicting the time required for the alteration signals. This decreases the fuel wastage in the vehicles and the pollution.

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